# IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

**Patent Application**

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| **Case:** | 1-17-10 | | |
| **Serial No.:** | 10/780,248 | **Group Art Unit:** | 2883 |
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| **Examiner:** | J. M. Blevins | | |
| **Title:** | 1 X N Wavelength Selective Switch | | |

**COMMISSIONER FOR PATENTS**
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**SIR:**

## Appellant's Brief Under 37 C.F.R. 41.37

This is an appeal to the Board of Patent Appeals and Interferences from the Final Rejection dated February 25, 2009.

A Notice of Appeal was timely filed.

## Real Party in Interest

The real party in interest is Alcatel-Lucent USA Inc..

## Related Appeals and Interferences

There are no related appeals or interferences.

**Status of Claims**

Claims 1-35, are pending in this application. Claims 1-35 stand finally rejected.

The rejection of claims 1-35 is hereby appealed. A copy of the claims under appeal as now presented are appended to this brief in Appendix A.

**Status of Amendments**

The original claims were never amended, nor were any of the later-added claims.

**Summary of the Claimed Subject Matter**

The transmission capacity of fiber-optic communication systems has been increased significantly by the use of wavelength division multiplexing (WDM) techniques. In a WDM communication system, multiple channels—where each channel is differentiated by using a unique wavelength of light—carry modulated optical signals in a single optical fiber between a transmitter and a receiver. The transmitter uses an optical multiplexer to combine multiple channels into the fiber for transmission, and the receiver uses an optical demultiplexer to separate the optical channels for detection. A typical optical demultiplexer (demux) contains a single input port and multiple output ports, where each optical channel from the input port is mapped to a unique output port in sequential order. Optical multiplexers are simply demultiplexers operated in the reverse direction, where a specific wavelength has to be supplied to the correct input port to emerge at the output port as part of a multiplexed signal.

At least one prior art programmable optical multiplexer/demultiplexer has multiple ports arrange such that an independent reconfigurable connection can be established between any two of the device's ports for each optical wavelength that is supplied to the device as part of a wavelength division multiplexed signal. In one arrangement, a programmable demultiplexer receives an input signal containing components at N different wavelengths at a port of the arrangement that acts as an input port, and distributes the input signal components among K ports that act as output ports. The input signal is collimated by a particular microlens in a microlens array, the particular lens being aligned to the input port. The microlens array contains K additional microlenses, each of which is aligned with a respective one of the K output ports. The resultant collimated beam originating from the input port is then made incident on a diffraction grating, which angularly disperses the composite optical signal according to wavelength, thereby forming N separate beams, each being at a different wavelength and having a distinct propagation angle. Each of the N separate beams propagates to a single lens that is arranged to collect all the beams and provide, for each wavelength, a

converging beam focused onto a particular micro mirror in an array containing N micro mirrors. Each mirror in the array is individually controlled to reflect the incident beam, which is at least one of the various wavelengths, in a desired direction, such that it will (a) re-enter the lens, (b) be collimated by the lens and redirected to a different location on the diffraction grating, and (c) be eventually coupled from the diffraction grating through a particular microlens in the microlens array to a desired output port, the particular microlens being aligned with the desired output port.

Generally, the number of output ports K and optical wavelength components N are independent. The demultiplexer can be designed to operate in the regime where K=N, so that each wavelength component can be assigned to any output port. The arrangement can also be operated in a mode where K<N, in which case more than one wavelength is applied to an output port, or in a mode where K>N, in which case one or more output ports are not used. In any event, the arrangement enables assignment of any wavelength to any output port

Such an arrangement may also be operated in the "reverse" direction, in order to act as a programmable multiplexer, rather than as a demultiplexer. In the multiplexer arrangement, K input signals, each containing one or more different wavelengths, are received from a plurality of K optical input ports and must be combined and made available at a single output port. The K input signals cumulatively contain a total of N different wavelengths, or, stated differently, any particular wavelength component can exist at only one of the K input ports. If this criterion is not met, contention will occur. Each input signal is collimated by a respective microlens in a microlens array that contains K+1 microlenses. One microlens is aligned with the output port, while the remaining microlenses are aligned each to a corresponding input port. The resultant collimated beam originating from each input port is then made incident on a diffraction grating, which diffracts the optical signal as a function of its wavelength. The diffraction grating is arranged such that all of the separate beams, which have different wavelengths and therefore distinct propagation angles, propagate to a single microlens that collects all of the beams and provides, for each wavelength, a converging beam focused onto a particular micro mirror in a micro mirror array. Each micro mirror in the array is individually controlled to reflect the incident beam, representing a corresponding wavelength in the desired direction, such that it will (a) re-enter the microlens, (b) be collimated by the microlens and redirected to a single location on the diffraction grating, and (c) be eventually coupled from the diffraction grating to the output port through the particular microlens in the microlens array that is aligned with the output port.

Again, in general, the number of input ports K and optical wavelength components N are independent. The multiplexer can be designed to operate where K=N, so that each wavelength component can originate at any input port. The arrangement can also be operated in a mode where K<N, in which case more than one wavelength is applied to an input port, or in a mode where K>N, in which case one or more input ports are not used. In any event, the arrangement enables multiplexing of all input wavelengths originating at the K input ports to the output port.

Disadvantageously, such an arrangement is too expensive for a small number of wavelengths, because it requires the same costly precise alignment of all components independent of the number of wavelengths employed, so the per-wavelength cost is high for a small number of wavelengths. Such an arrangement is also relatively inflexible in regards to its wavelength splitting abilities. More specifically, the bandwidth is distributed homogenously over a plurality of micro mirrors. The mirror dimensions must be chosen to correspond to the desired wavelength bandwidth. This makes it desirable to have the smallest possible spacing between the mirrors. Furthermore, if there is a gap between the mirrors, there will be a gap between the wavelengths.

We have recognized that the disadvantages of prior art 1 X N wavelength selective switches may be overcome, in accordance with the principles of the invention, by employing at least one wavelength sieve/combiner that operates on discrete wavelength units and is optically interposed between an array of optical sources and sinks, such as optical fibers, and an array of micro mirrors.

Each wavelength sieve/combiner can split a wavelength division multiplexed (WDM) beam into various discrete wavelength unit beams each of which contains prescribed wavelength channels, or it can cause multiple copies of part or all of the wavelengths to be supplied as outputs. Each wavelength sieve/combiner may also function in the opposite direction to combine such various beams into one wavelength division multiplexed beam. Typically, each fiber is associated with one wavelength sieve/combiner.

Each wavelength sieve/combiner may be implemented by placing at least one thin film filter along at least a first side of a substrate, such as a glass plate. Typically, more than one thin film filter is employed, e.g., one for each wavelength channel to be split out of, or combined into, a WDM beam. The second, opposite, side of the glass plate may include reflective portions to guide light not passed by any previously encountered thin film filters onto the next thin film filter. In other embodiments of the invention, the second side of the glass may also contain additional thin film filters to allow prescribed wavelength channels to exit from that side of the glass. In such embodiments of the

invention an additional focusing system and array of micro mirrors located on that second side of the glass may be employed to focus and reflect beams exiting from the second side of the glass. The wavelength sieve/combiners may be arranged adjacent to one another, e.g., at the same spacing as fibers. Preferably, the wavelength sieve/combiners are formed in an integrated fashion on a single substrate. For example, the parallel strips of the thin film filters may be placed on the substrate in the same direction as the fibers are adjacent to each other.

A wavelength sieve/combiner may also be implemented in a free-space version by suspending appropriately the necessary filter and reflective elements. Also, substrates other than glass may be employed, so long as they do not cause undue attenuation of the wavelengths of interest.

Preferably, the beams between a wavelength sieve/combiner and the micro mirror array should be converging to the plane of the micro mirror array. This may be achieved by employing a focusing system that focuses the output beams from the wavelength sieve/combiner onto the array of micro mirrors. Such a focusing system may be, for example, a cylindrical lens or a stack of segmented spherical lenses assembled together with one segment for each respective wavelength sieve/combiner. Alternatively, the beams from the fibers may be made converging as they emerge from the fibers. In such an embodiment of the invention, a prism may be interposed between a wavelength sieve/combiner and the micro mirror array to appropriately line-up the beams.

Primarily, the micro mirrors are arranged to tilt about a first axis, which is the axis that the mirrors would have in common when stacked one on top of the other. It is also advantageous, for purposes of hitless switching and to alleviate alignment requirements, for the micro mirrors to be able to tilt around a second axis, orthogonal to the first axis. Tilting about the second axis is used for hitless switching because such tilting essentially takes the micro mirror "offline" by reflecting the beam out of the surface of a sieve/combiner. The micro mirror is then tilted around its first axis to the desired new position that accommodates a change in output requirements, and then tilted around the second axis back "online", so the beam now hits the new appropriate thin film filter on the sieve/combiner. Advantageously, while the micro mirror is tilted offline, its beam will not be accidentally directed to an incorrect output fiber, which may otherwise occur should the tilt of the mirror about the first axis be changed while the micro mirror is online. Alignment requirements of the micro mirrors are alleviated because they may be tilted about the second axis once the system is operational to compensate for any slight misalignment.

Advantageously, in contrast to the prior art system, due to the discrete nature of the wavelength units processed by a wavelength sieve/combiner, the beam width on the micro mirror is independent of the bandwidth of a data signal being carried by the beam.

If the thin film filters employed are not wavelength selective, but instead simply pass only a portion of all of the wavelengths, e.g., 10%, multiple copies of the input signal can be created. Each copy may then be routed to an output fiber, thus providing a broadcast function. Similarly, only some of the wavelengths may have only a portion passed, thereby creating copies of those wavelengths.

Independent claim 1 is supported by FIGs. 1-8. In particular, FIG.1 shows a three-dimensional view of a 1 X N wavelength selective switch that employs at least one wavelength sieve/combiner, each of which operates on discrete wavelength units and is optically interposed between an array of fibers and an array of micro mirrors, in accordance with the principles of the invention. In more detail, elements of FIG. 1 that support claim 1 are a) optical fibers 101-1 through 101-N, collectively optical fibers 101; b) integrated wavelength sieve/combiners 105-1 to 105-N, collectively integrated wavelength sieve/combiner 105; and c) micro mirrors 109-1 through 109-N, which collectively form micro mirror array 109. Corresponding support in the specification is found at page 3, line 18 through page 5, line 10; page 8, line 3 through page 12, line 16.

Independent claim 31 is supported by FIGs. 1-8. In particular, FIG.1 shows a three-dimensional view of a 1 X N wavelength selective switch that employs at least one wavelength sieve/combiner, each of which operates on discrete wavelength units and is optically interposed between an array of fibers and an array of micro mirrors, in accordance with the principles of the invention. In more detail, elements of FIG. 1 that support claim 1 are a) optical fibers 101-1 through 101-N, collectively optical fibers 101; b) integrated wavelength sieve/combiners 105-1 to 105-N, collectively integrated wavelength sieve/combiner 105; and c) micro mirrors 109-1 through 109-N, which collectively form micro mirror array 109. Corresponding support in the specification is found at page 3, line 18 through page 5, line 10; page 8, line 3 through page 12, line 16.

## Grouping of Claims

All of the claims are apparatus. Claims 1 and 31 are independent claims using different language to capture the inventive concept, so that, for purposes of this appeal, each of the groups made up of one of the respective independent claims and its associated dependent claims, if any, stand and fall as does their independent claim. Applicants reserve the right to pursue the various dependent claims in the future should they determine it to be advantageous to do so.

**Grounds of Rejection to be Reviewed on Appeal**

1. Are claims 1-35 properly rejected under 35 U.S.C. 103(a) as being obvious in view of United States Patent Number 6,606,427 issued Graves et al. on August 12, 2003 in view of United States Patent Publication Number 2003/0128917 applied for by Turpin et al. which was published on July 10, 2003 by themselves, or in combination with various other references.

**Argument**

**Issue I – Rejection of Claims 1-35 Under 35 U.S.C. 103(a)**

Claims 1-35 are rejected under 35 U.S.C. 103(a) as being obvious in view of United States Patent Number 6,606,427 issued Graves et al. on August 12, 2003 in view of United States Patent Publication Number 2003/0128917 applied for by Turpin et al. which was published on July 10, 2003 by themselves, or in combination with various other references.

Applicants respectfully disagree and traverse these grounds of rejection for at least the following reasons.

Applicants' claimed wavelength sieve/combiner, is defined on page 8, line 35 to page 9, line 4 of the specification as a device that can split a wavelength division multiplexed (WDM) beam into various discrete wavelength unit beams each of which contains prescribed wavelength channels, or it can cause multiple copies of part or all of the wavelengths to be supplied as outputs. Furthermore, each wavelength sieve/combiner may also function in the opposite direction to combine such various beams into one wavelength division multiplexed beam.

The Office Action is of the opinion that this is a functional description, rather than a definition, and as such this functional description cannot be properly read into the claim. Applicants do not dispute that this is a functional description, but respectfully disagree with the suggestion of the Office Action that a functional description cannot constitute a definition. Rather, applicants believe that what they have provided is the most appropriate form of definition for their device, which is a functional definition, i.e., the definition is given by describing the function of the device. The particular details of

how the device achieves those functions is not relevant at the point of the definition, so it is not provided there, although various ways those functions may be achieved are described in the specification. Thus, applicants have provided an appropriate definition, which appears to be the only appropriate definition, and as such, must be imported into the claims, to the exclusion of any other definition that one might decide to inappropriately ascribe to applicants' carefully chosen words.

In this regard, note that "wavelength sieve/combiner" is used in applicants specification as a defined term, and the term was selected and defined only after due consideration of the nature of the device and the then-known prior art (which included diffraction gratings). Note that "wavelength sieve/combiner" is **not** a generic term, **nor** is it a conventional term. In fact, a search on the Google™ search engine for the exact term wavelength sieve/combiner, i.e., for "wavelength sieve/combiner" (where the quotation marks are part of what is typed into the search box to insure that exactly the character string within the quotation marks is searched for) yields only four results, all of which point to the instant application. In fact, repeating the search but omitting the word wavelength also yields the same results. Clearly then, one can**not** look anywhere else but to the instant specification for the definition of the term "wavelength sieve/combiner", and this definition must then be exclusively employed to appropriately determine the meaning of the claims.

Since wavelength sieve/combiner is **not** a generic or conventional term, but rather a defined term, the individual words of the term cannot be interpreted independently to determine the meaning of wavelength sieve/combiner when construing the claims. Rather, consistent with the well-known principle of patent law that an applicant may be his own lexicographer, one must use the definition of wavelength sieve/combiner that is provided in the specification.

Applicants note that their contention that wavelength sieve/combiner is a defined term is further supported by the fact that the definition of wavelength sieve/combiner is given immediately after the one sentence statement of the principles of the invention in the summary of the invention section of the specification in which the term wavelength sieve/combiner is first used. Moreover, immediately thereafter an explanation is given as

to how to implement the wavelength sieve/combiner. Indeed, such an organization of the summary of the invention section was necessary because the wavelength sieve/combiner is **not** a conventional or known device, but rather it is a specially defined device, and without such an organization a reader would **not** have been able to understand what the invention is. Furthermore, if the wavelength sieve/combiner was a conventional device, it would have simply sufficed, and would been considerably simpler, for applicants to merely state that wavelength sieve/combiners are well known in the art. That applicants did **not** do so reinforces the idea that applicants recognized that wavelength sieve/combiners were **not** known in the art at all and needed to be defined.

Thus, the explanation as to what is a wavelength sieve/combiner is **not** some mere detail of the specification that is not to be imported into the claims when construed by the USPTO. Rather, the explanation as to what is a wavelength sieve/combiner is an essential definition without which the claim cannot be understood at all. Therefore, it is imperative that the definition of wavelength sieve/combiner be included in construing the claim.

In short, this is **not** a situation of interpreting the claims in light of the specification without reading limitations from the specification into the claims. Rather, this is a case where the essential definition of an element of the claims cannot be found anywhere else, e.g., cannot be found in a dictionary or other reference book, but can only be found in the specification. As a result, the definition of the element provided in the specification must be wholly imported into the claim to provide the meaning for the element and to give the claim proper scope for examination purposes.

Once the claim is properly construed using the appropriate meaning for the term "wavelength sieve/combiner", it is clear the rejection can**not** be maintained. This is because the main argument of the Office Action is that the optical tapped delay line (OTDL) of Turpin et al. is the same as applicants' wavelength sieve/combiner, which can then be substituted into the arrangement of Graves et al. to achieve applicants' claimed invention. However, even if it were obvious to make such a substitution, which applicants are **not** admitting, the assumption that the OTDL of Turpin et al. is the same as applicants' wavelength sieve/combiner is incorrect.

Applicants' claimed wavelength sieve/combiner can split a wavelength division multiplexed (WDM) beam into various discrete wavelength unit beams each of which contains prescribed wavelength channels, or it can cause multiple copies of part or all of the wavelengths to be supplied as outputs. Furthermore, applicant's wavelength sieve/combiner may also function in the opposite direction to combine such various beams into one wavelength division multiplexed beam.

By contrast, the OTDL of Turpin et al. appears to operate in a manner that achieves the same result as is achieved by a diffraction grating, which applicants have previously distinguished from their wavelength sieve/combiner, a distinction with which the Office Action has previously agreed. In particular, the OTDL of Turpin et al. does **not** correspond functionally to applicants' recited element in that the OTDL divides the input signal into continuous and contiguous spectral regions that are analogous to a rainbow. In other words, such the OTDL divides up the spectrum in a continuous and fixed manner by wavelength, and the spatial location at which each particular frequency of light appears is determined based on the wavelength and cannot be independently controlled. (See for example Turpin et al, paragraph 360, Figure 45.)

Furthermore, the OTDL of Turpin et al. can**not** cause multiple copies of part or all of the wavelengths to be supplied as outputs, which is yet a further requirement for a device to be applicants' recited wavelength sieve/combiner.

Note that because applicants' wavelength sieve/combiner can split a wavelength division multiplexed (WDM) beam into various discrete wavelength unit beams each of which contains prescribed wavelength channels, the channels need **not** all have the same wavelength band. Certainly if all the channels simply have the same wavelength band, and there aren't any multiple copies of part or all of the wavelengths to be supplied as outputs, or vice-versa when used to combine, then all that remains is simply a conventional demultiplexer or multiplexer. However, this is **not** what applicants' claim language calls for, given that it recites a wavelength sieve/combiner.

Thus, Turpin et al. does **not** teach applicants' recited wavelength sieve/combiner. Consequently, substituting the OTDL of Turpin et al. for the wavelength multiplexer/demultiplexer of Graves et al. does **not** achieve applicants' claimed

invention, and so applicants' independent claims 1 and 31 are allowable over the combination of Graves et al. and Turpin et al. under 35 U.S.C. 103.

With regards to the dependent claims, all of the rejections are premised on the validity of the argument that OTDL of Turpin et al. is applicants' recited wavelength sieve/combiner. However, since it has been shown that the OTDL of Turpin et al. is **not** applicants' recited wavelength sieve/combiner, as described hereinabove, and there is no argument put forth by the Office Action that any of the other cited references supplies applicants' recited wavelength sieve/combiner so as to render the independent claims obvious, these grounds of rejection cannot be maintained.

Therefore, applicants' claims 1-35 are allowable under 35 U.S.C. 103.

**Conclusion**

In view of the foregoing, it is submitted that the Examiner is in error. It is, accordingly, respectfully requested that the rejection of claims 1-35 be reversed and the application passed to issue.

Respectfully,

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## Claims Appendix

Claims

1. An apparatus, comprising:

an array of optical fibers;

at least one wavelength sieve/combiner that operates on discrete wavelength units; and

a first array of micro mirrors;

wherein said optical wavelength sieve/combiner is optically interposed between said array of optical fibers and said array of micro mirrors.

2. The invention as defined in claim 1 wherein any wavelength within one of said discrete wavelength units is supplied to or received from the same beam position by said wavelength sieve/combiner.

3. The invention as defined in claim 1 further comprising an array of micro lenses, one micro lens for each optical fiber in said array of optical fibers, said micro lenses being optically interposed between said array of optical fibers and said wavelength sieve/combiner.

4. The invention as defined in claim 1 further comprising an array of collimators, one collimator for each optical fiber in said array of optical fibers, each of said collimators being attached to one of said optical fibers, said collimators being optically interposed between said optical fibers and said wavelength sieve/combiner.

5. The invention as defined in claim 1 further comprising a first focusing system that focuses output beams from said wavelength sieve/combiner onto said first array of micro mirrors.

6. The invention as defined in claim 5 wherein said first focusing system comprises a lens.

7. The invention as defined in claim 5 wherein said first focusing system comprises a prism.

8. The invention as defined in claim 1 wherein said wavelength sieve/combiner comprises at least one thin film optical filter.

9. The invention as defined in claim 8 wherein said at least one thin film optical filter is mounted on a substrate.

10. The invention as defined in claim 8 wherein said at least one thin film optical filter is mounted on a glass substrate.

11. The invention as defined in claim 8 wherein said at least one thin film optical filter is freespace suspended.

12. The invention as defined in claim 8 wherein said at least one thin film optical filter passes a portion of all of the wavelengths incident upon it and reflects a portion of all of the wavelengths incident upon it, whereby a copy of the incident wavelengths is created.

13. The invention as defined in claim 8 wherein said at least one thin film optical filter passes a portion of some of the wavelengths incident upon it and reflects a portion of some of the wavelengths incident upon it, whereby a copy of the incident wavelengths that a portion is passed for is created.

14. The invention as defined in claim 1 wherein there is a plurality of said wavelength sieve combiners.

15. The invention as defined in claim 1 wherein there is a plurality of said wavelength sieve combiners and each of said wavelength sieve/combiners is formed from respective portions of a plurality of strips of thin film optical filters.

16. The invention as defined in claim 1 wherein each of said at least one wavelength sieve/combiners is adapted to supply as output one beam for a discrete wavelength unit for each of a plurality of strips of thin film optical filters incorporated therein.

17. The invention as defined in claim 1 further comprising at least one sensor for detecting light at at least a prescribed one of said discrete wavelength units

18. The invention as defined in claim 17 wherein said at least one sensor is mounted on said at least one wavelength sieve/combiner.

19. The invention as defined in claim 1 wherein at least one micro mirror of said array of micro mirrors can tilt around two axes.

20. The invention as defined in claim 19 wherein each of said two axes are substantially orthogonal to the other.

21. The invention as defined in claim 1 further comprising

a second array of micro mirrors;

wherein said optical wavelength sieve/combiner is also optically interposed between said array of optical fibers and said second array of micro mirrors.

22. The invention as defined in claim 21 further comprising a focusing system that focuses output beams from said wavelength sieve/combiner onto said second array of micro mirrors.

23. The invention as defined in claim 5 further comprising:

a second array of micro mirrors, wherein said optical wavelength sieve/combiner is also optically interposed between said array of optical fibers and said second array of micro mirrors; and

a second focusing system that focuses output beams from said wavelength sieve/combiner onto said second array of micro mirrors.

24. The invention as defined in claim 23 wherein said first focusing system and said second focusing system are different.

25. The invention as defined in claim 23 wherein said first focusing system and said second focusing system are the same.

26. The invention as defined in claim 1 wherein said apparatus is adapted to operate at least in part in a broadcast mode.

27. The invention as defined in claim 1 wherein said apparatus is adapted to operate at least in part as a multiplexer.

28. The invention as defined in claim 1 wherein said apparatus is adapted to operate at least in part as a demultiplexer.

29. The invention as defined in claim 1 wherein said apparatus is adapted so that beams from said optical fibers are converging prior to encountering said at least one wavelength sieve/combiner.

30. The invention as defined in claim 29 further comprising a prism optically interposed between said wavelength sieve/combiner and said array of micro mirrors.

31. An apparatus, comprising:
a sieve/combiner; and
an array of micro mirrors;
wherein said sieve/combiner is optically interposed between said array of micro mirrors and an array of optical elements at least one of which is adapted to supply an optical beam to said apparatus and at least one of which is adapted to receive an optical beam from said apparatus.

32. The invention as defined in claim 1 wherein light travels between said sieve combiner and first array of micro mirrors only via a free space path.

33. The invention as defined in claim 32 wherein said free space path includes at least one element from the group consisting of a mirror, a lens, and a prism.

34. The invention as defined in claim 31 wherein light travels between said sieve/combiner and array of micro mirrors only via a free space path.

35. The invention as defined in claim 34 wherein said free space path includes at least one element from the group consisting of a mirror, a lens, and a prism.

**Evidence Appendix**

None

## Related Proceedings Appendix

None